Certification Test Report

FCC ID: R7PNG0R1S4
IC: 5294A-NG0R1S4

FCC Rule Part: 15.247
ISED Canada Radio Standards Specification: RSS-247

Report Number: AT72154175-2P0

Manufacturer: Landis+Gyr Technology, Inc.
Model: Series-6 RF Mesh mSBR Card

Test Begin Date: November 4, 2019
Test End Date: November 21, 2019

Report Issue Date: January 17, 2020

FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

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This report contains 20 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science, and Economic Development Canada's Radio Standards Specification RSS-247 Certification for Class II Permissive Change.

The purpose of this Class II Permissive Change is to add a new antenna to the originally certified module.

1.2 Product description

The Landis & Gyr Series-6 RF Mesh mSBR Card radio is an electricity metering module which includes a 900 MHz ISM transmitter as well as a 2.4GHz OFDM transmitter.

This test report documents the compliance of the 900MHz Frequency Hopping Spread Spectrum transceiver mode of operation.

Technical Details:

Detail	Description
Frequency Range (MHz)	Mode 1: 902.4 – 927.6 MHz Mode 2: 904 – 926.8 MHz
Number of Channels	Mode 1: 64 Mode 2: 58
Channel Spacing	400kHz
Modulation Format	Mode 1: IEEE 802.15.4 SUN FSK, OFDM Mode 2: IEEE 802.15.4 SUN FSK
Data Rates	FSK: 50kbps, 100kbps, 150kbps, 200kbps OFDM Option 3: MCS3 – MCS6
Operating Voltage	3.3Vdc
Antenna Type(s) / Gain(s)	Dual Band Dipole / 4.5dBi (original) SkyWave 13-1904-B / 2 dBi max (new)

Manufacturer Information:
Landis+Gyr Technology, Inc.
30000 Mill Creek Ave., Suite 100
Alpharetta, GA 30022

Test Sample Serial Number: LAN ID: 61293EB1

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable. The worst-case data rate for FSK modulation was 50kbps. The worst-case data rate for OFDM Option 3 modulation was MCS3.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was Z-position. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

For AC power line conducted emissions the EUT was evaluated with a commercially available wall wart power supply. The EUT was programmed to generate a random modulated signal on the worst-case channel.

Radiated inter-modulation testing was performed for all combinations of simultaneous transmission and found to be compliant.

Software power setting during test: 29.5

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following addresses:

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Designation Accreditation Number:	US1233
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

The Semi-Anechoic Chamber Test Site consists of a 20’ x 30’ x 18’ shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 5’ in diameter and is located 5’6” from the back wall of the chamber. The chamber is grounded via 1 - 8’ copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted EMCO Model 1060 installed in an all steel frame. The table is remotely operated from inside the control room located 25’ from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3’ x 6’ x 4’ deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4” PVC chase from the turntable to the pit that allows for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

The chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

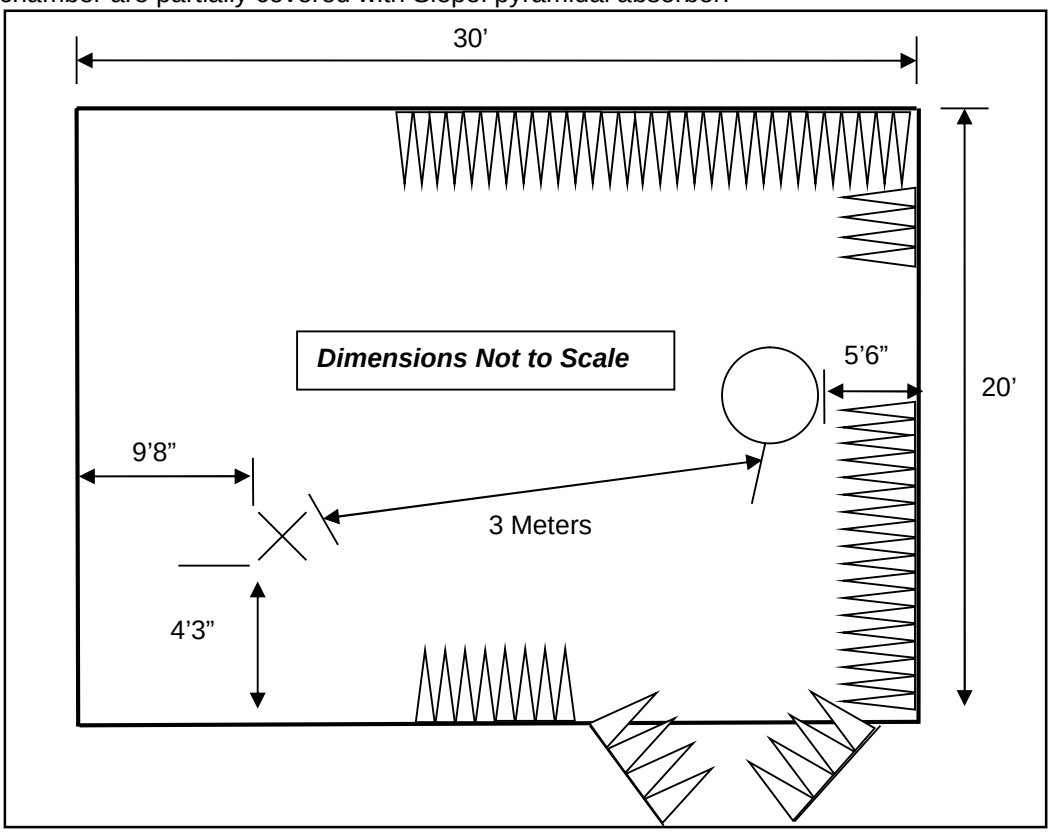


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

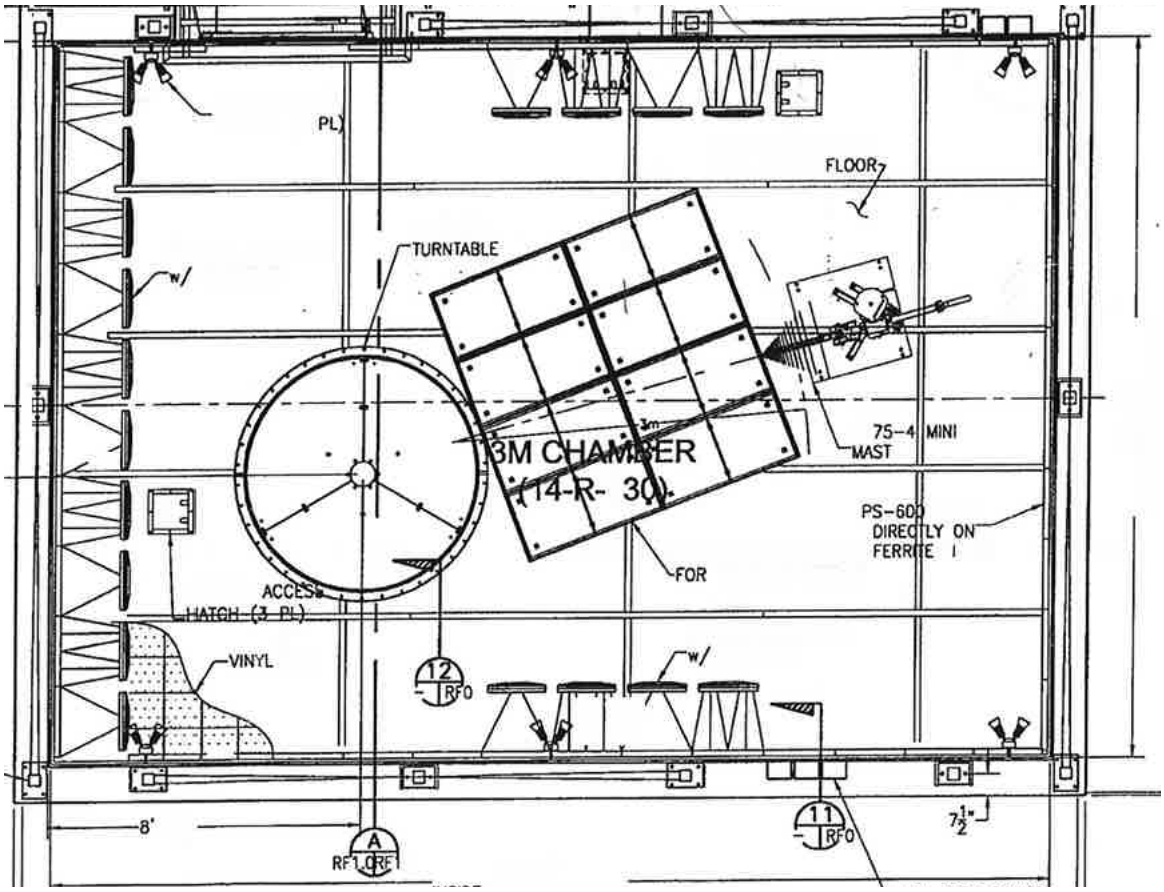


Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane (HCP) as well as a 12'x8' vertical coupling plane (VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test tabletop and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

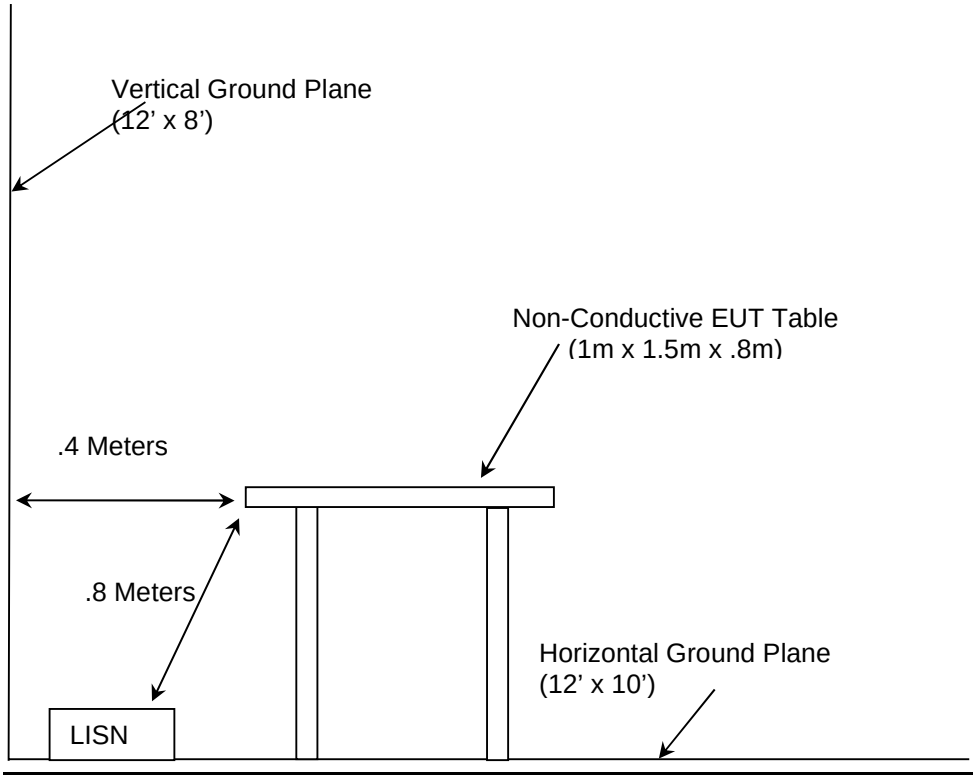


Figure 2.4.1-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2019
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2019
- FCC KDB 558074 D01 DTS Meas Guidance v05r02 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 2, 2019
- ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, April 2018.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/29/2019	05/29/2021
321	Hewlett Packard	HPC 8447D	Low Freq. Pre-Amp	1937A02809	09/12/2019	09/12/2020
324	ACS	Belden	Conducted EMI Cable	8214	03/19/2019	03/19/2020
337	Microwave Circuits	H1G513G1	Microwave Bandpass Filter	282706	05/31/2019	05/31/2020
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/15/2019	07/15/2021
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	02/11/2019	11/02/2021
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz	697WW30606	02/25/2019	02/25/2020
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	11/01/2019	05/01/2020
851	TUV ATLANTA	FMC0101951-100CM	ASAC Cable Set Consisting of 566, 619, and 564	N/A	10/01/2019	10/01/2020
852	Teseq	CBL 6112D	Bilog Antenna; Attenuator	51617	10/15/2018	10/15/2020
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	07/10/2019	07/10/2020

NOTE: All test equipment was used only during active calibration cycles.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	Host Board	Landis & Gyr	**ICB DEV KIT**	**25-2493**
2	AC Adapter	Mean Well	**GST36B12**	**Not Labeled**

Table 5-2: Cable Description

Cable	Cable Type	Length	Shield	Termination
A	RF Antenna Coax	15 cm	Yes	EUT to Antenna
B	DC Power Cable	1.25 m	No	EUT to Power Supply
C	AC Power Cable	2 m	No	Power Supply to AC Mains

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

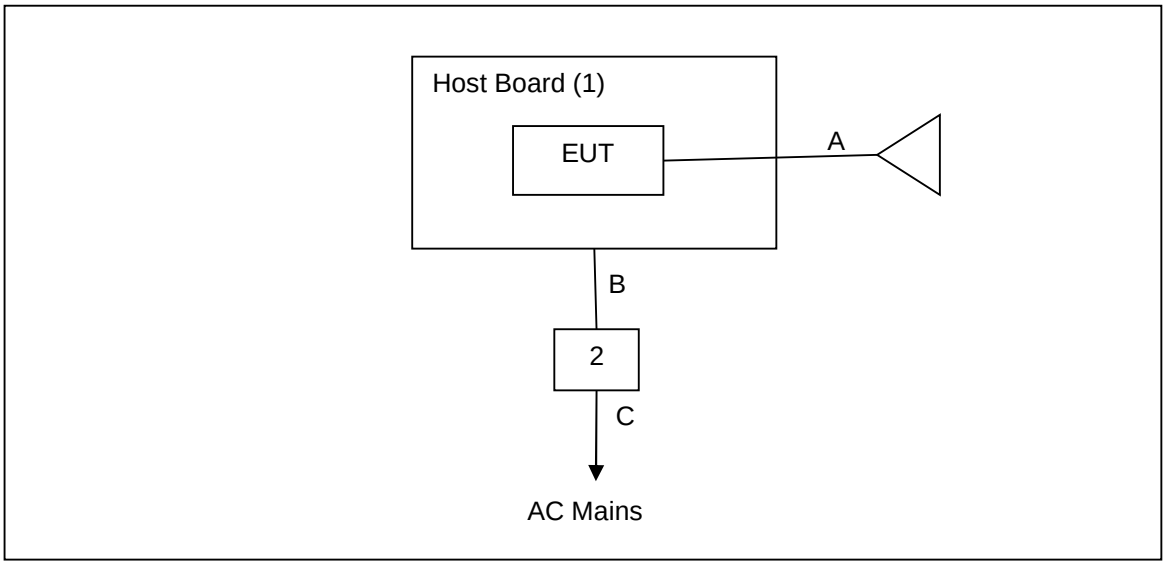


Figure 6-1: Test Setup Block Diagram

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC 15.203

The EUT utilizes a new dual band patch antenna. Connection to the module is via a U.fl adapter cable which is a unique connection. The max gain of the antenna is 2 dBi.

7.2 Power Line Conducted Emissions – FCC 15.207, ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Corrected Reading – Applicable Limit

7.2.2 Measurement Results

Performed by: Eugene Sello

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)	
0.15	39.69	22.19	66	56	26.31	33.81	9.45
0.154	38.36	22.8	65.78	55.78	27.42	32.98	9.45
0.214	32.79	15.33	63.05	53.05	30.26	37.72	9.47
2.502	27.43	12.01	56	46	28.57	33.99	9.74
2.618	28.1	13.11	56	46	27.9	32.89	9.74
2.774	27.56	11.28	56	46	28.44	34.72	9.75
2.998	27.95	12.99	56	46	28.05	33.01	9.77
24.67	31.22	22.22	60	50	28.78	27.78	9.82
26.87	33.17	26.1	60	50	26.83	23.9	9.85
27.966	34.05	27.71	60	50	25.95	22.29	9.85

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)	
0.15	37.63	22.17	66	56	28.37	33.83	9.43
0.154	37.18	25.34	65.78	55.78	28.6	30.44	9.43
0.166	40.9	23.77	65.16	55.16	24.26	31.39	9.43
0.182	40.8	21.28	64.39	54.39	23.59	33.11	9.44
0.246	36.77	14.57	61.89	51.89	25.12	37.32	9.44
2.986	27.72	13.23	56	46	28.28	32.77	9.72
13.734	25.18	11.15	60	50	34.82	38.85	9.71
26.898	30.08	15.29	60	50	29.92	34.71	9.88
27.986	31.16	18.65	60	50	28.84	31.35	9.9
28.514	33.95	25.39	60	50	26.05	24.61	9.91

7.3 Spurious Emissions

7.3.1 Radiated Spurious Emissions – FCC: Section 15.205, 15.209; ISED Canada: RSS-Gen 8.9/8.10

7.3.1.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

The EUT was caused to generate a continuous modulated carrier on the hopping channel. Prescan plots were taken at a 1 meter horizontal measurement distance to identify emission frequencies of interest only. See Appendix A for prescan plots.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

7.3.1.2 Measurement Results

Performed by: Ryan McGann

Table 7.5.3.2-1: Radiated Spurious Emissions Tabulated Data (FSK 50kHz)

Frequency (MHz)	Level (dBµV)		Antenna Polarity	Correction Factors	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
2707.2	48.60	36.70	H	-0.79	47.81	35.91	74.0	54.0	26.2	18.1
2707.2	50.80	42.10	V	-0.79	50.01	41.31	74.0	54.0	24.0	12.7
Middle Channel										
2745.6	49.70	39.60	H	-0.54	49.16	39.06	74.0	54.0	24.8	14.9
2745.6	52.00	45.10	V	-0.54	51.46	44.56	74.0	54.0	22.5	9.4
High Channel										
2782.8	49.30	36.90	H	-0.31	48.99	36.59	74.0	54.0	25.0	17.4
2782.8	50.40	40.90	V	-0.31	50.09	40.59	74.0	54.0	23.9	13.4

Table 7.5.3.2-2: Radiated Spurious Emissions Tabulated Data (OFDM MCS3)

Frequency (MHz)	Level (dBµV)		Antenna Polarity	Correction Factors	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
2707.2	48.10	35.80	V	-0.79	47.31	35.01	74.0	54.0	26.7	19.0
Middle Channel										
2745.6	48.90	35.60	V	-0.54	48.36	35.06	74.0	54.0	25.6	18.9
High Channel										
2782.8	50.30	36.40	H	-0.31	49.99	36.09	74.0	54.0	24.0	17.9
2782.8	51.70	38.60	V	-0.31	51.39	38.29	74.0	54.0	22.6	15.7

7.3.1.3 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U = Uncorrected Reading
R_C = Corrected Level
AF = Antenna Factor
CA = Cable Attenuation
AG = Amplifier Gain
DC = Duty Cycle Correction Factor

Example Calculation: Peak – FSK 50kbps

Corrected Level: 52.00 + -0.54 = 51.46dBuV/m
Margin: 74dBuV/m – 51.46dBuV/m = 22.5dB

Example Calculation: Average – FSK 50kbps

Corrected Level: 45.10 + -0.54 - 0 = 44.56dBuV
Margin: 54dBuV – 44.56dBuV = 9.4dB

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

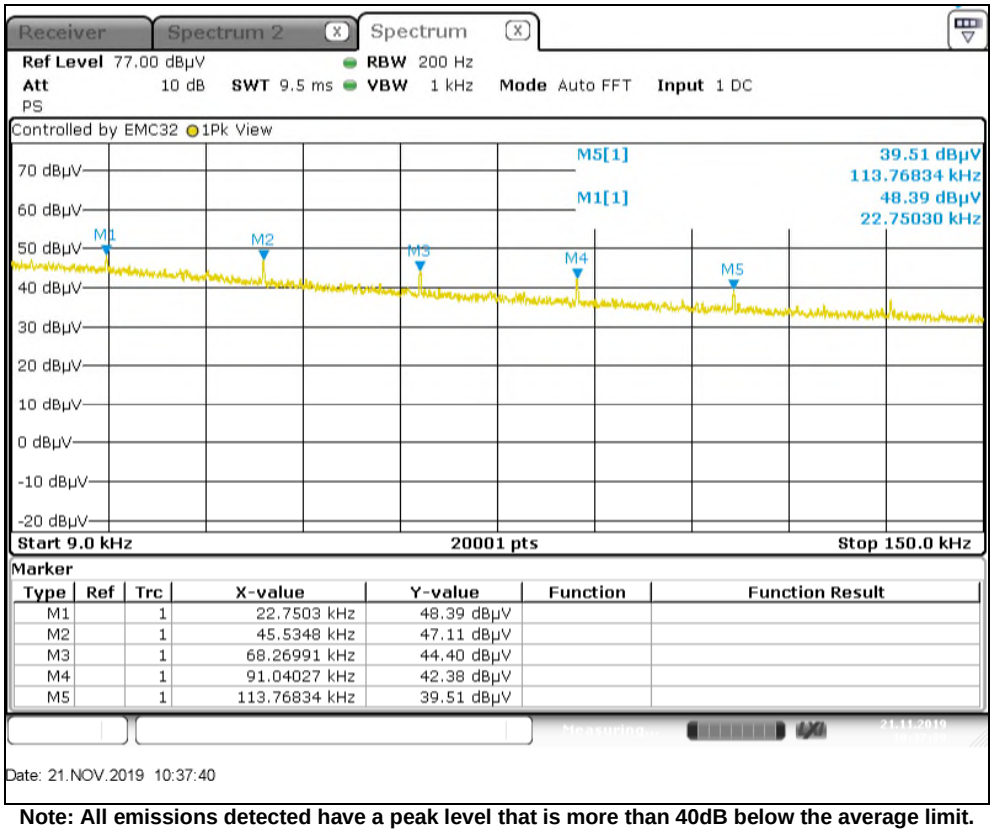
Table 8-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 0.349 dB
Power Spectral Density	± 0.372 dB
Antenna Port Conducted Emissions	± 1.264 dB
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	± 2.832 x 10^{-8}
AC Power Line Conducted Emissions	± 3.360 dB

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the Series-6 RF Mesh mSBR Card, manufactured by Landis+Gyr Technology, Inc. meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

Appendix A: Plots



Note: All emissions detected have a peak level that is more than 40dB below the average limit.

Figure A-1: Radiated Emissions – 9kHz-150kHz

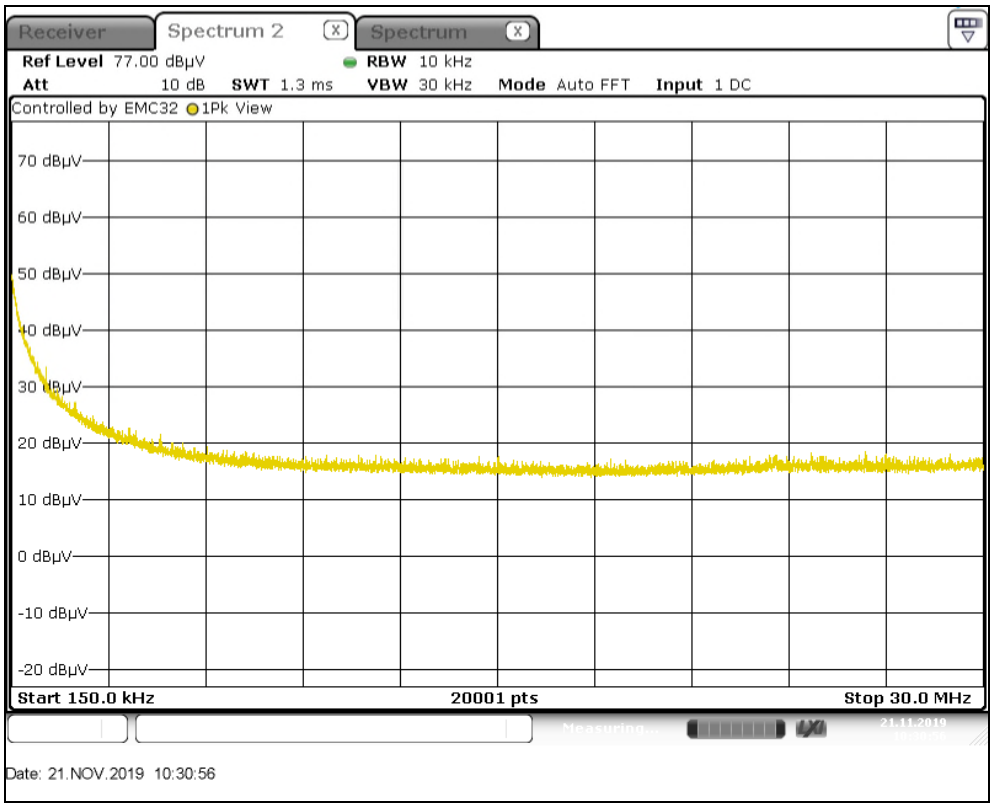
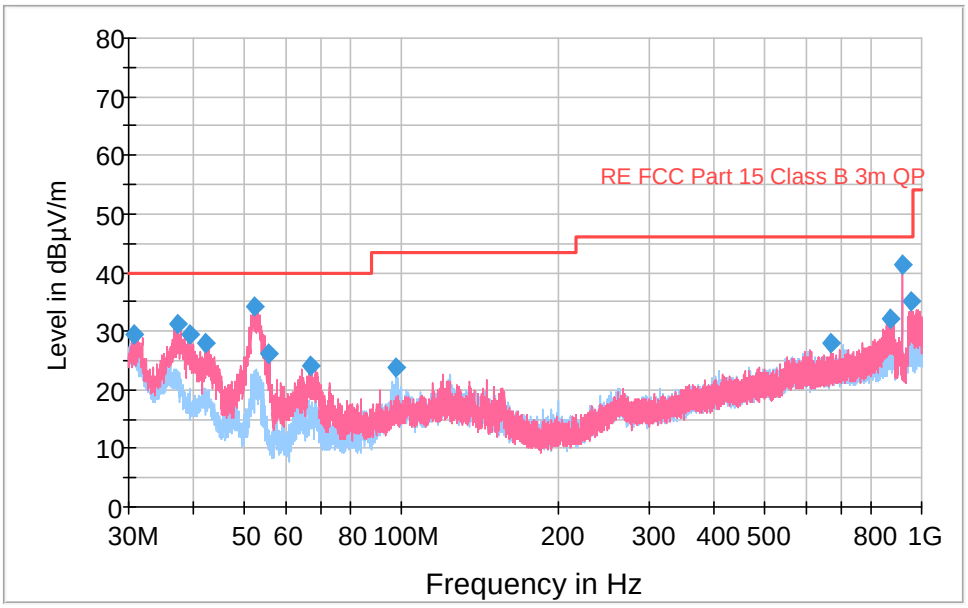


Figure A-2: Radiated Emissions – 150kHz-30MHz

Full Spectrum



Note: Emissions above the noise floor are from the digital sections of the DUT and not associated with the radio.

Figure A-3: Radiated Emissions – 30MHz-1GHz

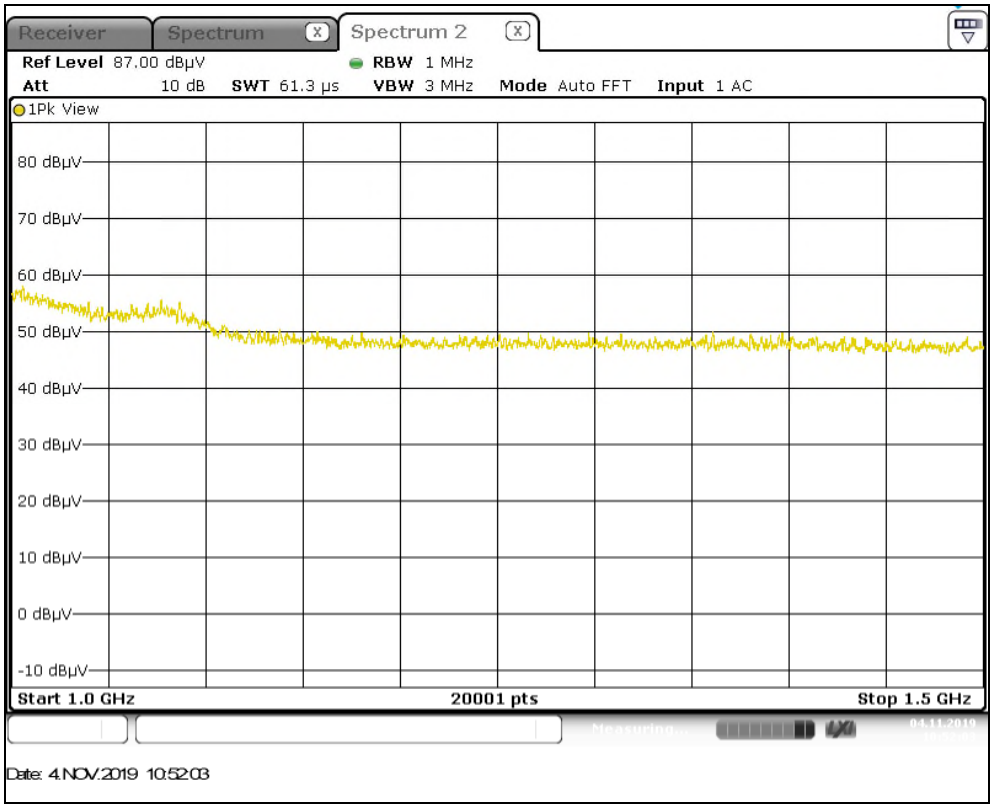
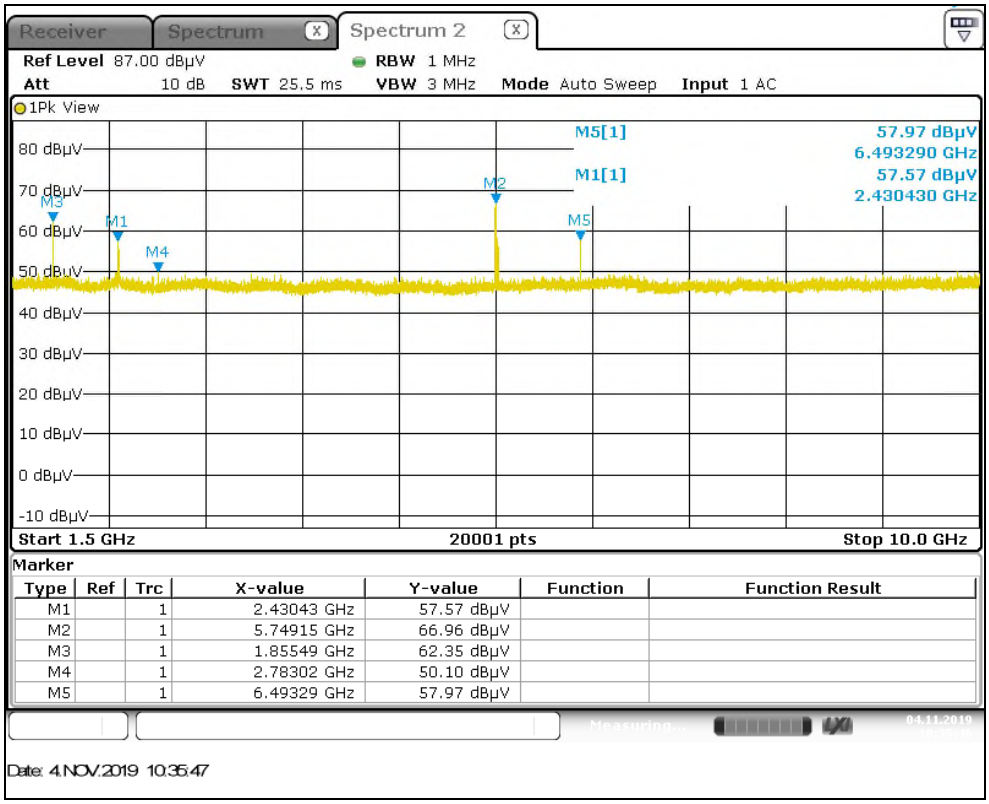


Figure A-4: Radiated Emissions – 1GHz-1.5GHz



Note: Marker 1 and 2 are local ambient emissions, not associated with the EUT.

Figure A-4: Radiated Emissions – 1.5GHz-10GHz

END REPORT